Friends will be friends: IPO Pricing and the Network Game

Manuela Geranio[a], *Camilla Mazzoli*[b], *Fabrizio Palmucci*[c]

14th January 2019

We study how repeated interactions (i.e. network) between lead underwriters and institutional investors influence pricing in the IPO market. Based on a sample of 3219 US IPOs between 1997 and 2016 we find that larger networks contribute to the reduction of information asymmetries in the primary market, leading to a higher price adjustment, which supports the bookbuilding theory. At the same time, we introduce a novel methodology which allows us to unveil that larger networks also reduce the partial adjustment, leading to an excess underpricing in the secondary market, thus supporting the agency theory. This effect is stronger in hot IPOs and slightly reversed in cold IPOs, suggesting an intertemporal quid pro quo between the players in the game. Our results are robust to different measures of network and to different time frames in which the network is analyzed.

EFM code
230 - Securities Issuance
110 - Agency Theory and Contracting Problems

JEL Classification: G24, G31, G23

Keywords: repeated interactions; initial public offerings; network; underpricing; information asymmetries.

[a] *Department of Finance, Bocconi University, Via Roentgen 1, 20136 Milano, Italy; manuela.geranio@unibocconi.it*
[b] *Department of Management, Università Politecnica delle Marche, P.le Martelli 8, 60121 Ancona, Italy; c.mazzoli@staff.univpm.it*
[c] *Department of Management, University of Bologna, Via Capo di Lucca 34, 40126 Bologna, Italy; f.palmucci@unibo.it*

1. Introduction

For years, the US Initial Public Offering (IPO) market has been setting a benchmark for international stock exchanges and it has attracted thousands of firms on US exchanges. Nevertheless, the recent shrinking of the US IPO market might represent a sign of the reduced willingness of companies to get listed (Doidge et al., 2017). The lack of transparency in IPO pricing and allocation procedures adopted may cast some doubts on the fairness of the IPO process (Jenkinson et al., 2018) and possibly plays a role in fostering issuers' disaffection for IPOs.

Academic literature offers several theoretical and empirical contributions studying repeated interactions between institutional investors and lead underwriters (from hereafter 'network' relationships), with the purpose of understanding to what extent such relationships might affect the fair functioning of IPOs. A key aspect of the IPO process is the behavior of the lead underwriters, who should fairly price and allocate the shares serving both the interests of the issuing firms and that of the investors. Previous literature has expressed conflicting views regarding the lead underwriter's behavior towards regular investors and the foreseeable consequences for both the issuer and non-regular investors: bookbuilding theory on the one side and agency-based theory on the other.

Bookbuilding theory builds on the idea that new issues should be on average underpriced to overcome the winner's curse problem (Rock, 1986), but then it predicts that lead underwriters will develop regular relationships with informed investors that help the information production process and allow them to reduce the underpricing (Benveniste and Spindt, 1989; Benveniste and Wilhelm, 1990; Hanley, 1993; Sherman and Titman, 2002). Under this framework, regular investors accept a lower underpricing in exchange for future priority in allocations of underpriced IPOs managed by the same underwriter.

Differently, agency-based theory (Ritter and Welch, 2002; Loughran and Ritter, 2002; Reuter, 2006; Degeorge, Derrien and Womack, 2007) maintains that lead underwriters might favor regular investors with highly underpriced shares in a quid pro quo exchange for other business lines, such as commission revenue from aftermarket trading (Reuter, 2006; Nimalendran et al., 2007; Jenkinson and Jones, 2009, Jenkinson et al., 2018), thus possibly leading to agency costs for the issuer.

Concerns about unfair behavior by lead underwriters in IPOs has also been interesting regulators and financial authorities: the growing concentration in investment banks and mutual fund industries could pave the way for an exclusive club favouring its own interests at the expense of both investors outside of the club and issuers. The former case has been addressed by US and European Regulators with provisions which constrain allocations that could favor some investors and discriminate against others. Less attention has been devoted to the possible discriminatory pricing effect that conflicts of interest might impose on the issuer, which is precisely the focus of this paper. In particular, with respect to the allocation issue, the U.S. FINRA rule 5131 (approved by the SEC in 2010), prohibits quid pro quo in the allocation of shares in an IPO. More recently, European and UK regulators have also compelled investment banks to implement disclosure policies in order to address conflicts of interest in IPO markets: the MiFID II regulation in January 2018 introduced in the European Union the obligation for bookrunners to keep a written record in order to justify the rationale adopted in the allocation policy of an IPO offer; similarly, in 2016, the FCA in the UK revealed a potential for conflicts of interest to arise in the allocation of shares in IPOs and declared that it expected banks to manage these potential conflicts of interest appropriately, including the implementation of allocation policies.

The cost and the opacity of the traditional IPO market have also fostered attempts at disintermediation. In 1999 the U.S. investment bank W.R. Hambrecht launched the OpenIPO platform to offer auction-based IPOs as an alternative to the traditional bookbuilding process in order to provide a cheaper and fairer allocation of shares among investors (Hurt, 2008). In 2004 Google used a Dutch auction method to price its IPO, halving the fees paid to investment banks (Ritter, 2014). More recently (2018) the Swedish digital streaming music company Spotify completed a Direct Public Offering (DPO) in which it self-underwrote its securities and offered them to the public without the intervention of any bookrunner, thus minimizing its total listing costs and keeping greater control over the deal. Although these cases cannot be generalised to all firms looking for a public listing, they clearly represent the urge for higher transparency and lower costs in IPOs.

In this scenario, it is extremely important to fully explore the effects that the existence of an underwriter-institutional investor network has on IPO pricing and on underwriters' fair behavior. Nevertheless, neither the academic literature nor practitioners have reached an agreement regarding to what extent the IPO pricing is affected by the presence of a network, and even less with regards to what extent this is a disadvantage for issuing firms.

Bookbuilding studies empirically support the idea that underwriter-investor networks tend to reduce underpricing. At the same time, contributions supporting agency theory (Binay et al., 2007; Gondat-Larralde and James, 2008; Jenkinson et al., 2018) do not find that networks produce a direct cost paid by issuers in terms of more money left on the table. The reason why previous authors did not find any direct link between networks and issuers' costs might lie in the methodology used; studies on the effect of networks on IPO pricing focused their attention on the underpricing measure alone. Nonetheless, the underpricing summarizes the performance of the stocks in the secondary market, therefore it is not enough to investigate the effects of networks on the lead underwriters' fair pricing behavior.

In this paper, we propose a methodology which enlarges the perspective by considering both the distinguished upshots of the pricing process. More specifically, we separately relate the network characteristics to a specific primary market pricing measure (the price adjustment) and to the level of partial adjustment which relates the primary and the secondary market outcomes (Hanley, 1993). That being so, thanks to an innovative framework, we are able to set apart the effects that the network exerts distinctively in terms of information production process and in terms of potential opportunistic behaviors.

The contribution of this paper relative to the existing literature builds on three results. First, we find confirmation of the bookbuilding theory in that we find a strong positive relation between past underwriter-investor interactions and information production, as measured by a larger offer price adjustment. Second, we find evidence that stronger networks might lead to a smaller partial adjustment of the offer price, which reveals a sort of excess underpricing and then an excess in the money left on the table. This second result suggests the presence of an agency cost that the lead underwriter discharges on the issuer to the advantage of institutional investors belonging to the network. Third, we find evidence of an intertemporal quid pro quo between lead underwriters and regular investors in that the former grants the excess underpricing to the latter in hot IPOs in exchange for participation in cold IPOs with below-average underpricing.

The rest of the paper is organized as follows: in section 2 we review the literature on the effects of repeated interactions on IPOs; in section 3 we present our models and hypotheses; section 4 reports the data and methodology adopted in the empirical analyses, while a discussion of our key findings is presented in section 5. In section 6 we explore alternative models and robustness checks, while section 7 concludes.

2. Literature review

The repeated nature of the relationships between lead underwriters and institutional investors taking part in IPOs has raised doubts about the potential for conflicts of interest. Nevertheless, a conclusion has not been reached in the literature regarding the consequences of such interactions for issuers.

On the one hand, the international evidence shows that countries that use bookbuilding typically have less underpricing than countries using fixed-price offerings (Ritter, 1998; Loughran, Ritter, and Rydqvist, 1994; Ljungqvist and Wilhelm, 2002), suggesting that bookbuilding might allow for a more appropriate collection of information about the true value of the stock and a more accurate pricing. Investors who participate in the bookbuilding and reveal information to the lead underwriters are likely to be compensated with a positive expected underpricing (Rock, 1986). Bookbuilding theory (Benveniste and Spindt, 1989; Benveniste and Wilhelm, 1990; Sherman and Titman, 2002) reasons that an underwriter's network of regular investors might support the information production process leading to a more efficient pricing of the IPO and maximizing the proceeds in the interest of the issuing firm (see also Bajo et al., 2016).

Alongside this, part of the literature suggests that conflicts of interests may lead underwriters to give favorable allocations of underpriced IPOs to institutional investors in a quid pro quo exchange for other business lines. Such agency-based theories maintain that the favourable allocations to an underwriter's network investors implies that the IPO offer price is set deliberately low in the primary market in order to benefit regular investors with a large underpricing, which ultimately represents a cost to the issuer. In particular, following the block-booking theory, Gondat-Larralde and James (2008) suggest that banks underprice each offering to the extent necessary to make remaining in the network the most profitable choice for regular investors. They search for the agency cost of the network to issuers in terms of share pricing, without finding evidence of it. Thus, they conclude that the bookbuilding is a fair method for placing IPOs and the money left on the table is a necessary cost to pay. Binay et al. (2007) find that their measure of network[1] is positively related to the level of underpricing, thus arguing that regular investors benefit from underwriters' favouritism. Nonetheless, authors do not investigate if any agency cost is dumped on the issuer.

Derrien (2002) proposes a model of how book-built IPOs are priced and placed by underwriters depending on market conditions and shows that favouritism towards regular investors mainly occurs in hot markets, when IPOs are easy to price and place because more investors are willing to buy newly issued shares at high prices. In this situation, bookbuilding is profitable for underwriters as well as for institutional investors, who receive favourable treatment and can profit by selling their shares on the aftermarket. On the other hand, in bearish markets, placing shares is a more difficult task. In this situation, bookbuilding offers a riskless solution to the underwriter, who can use the signals (the demand schedule) received from investors in his network (i.e. institutional investors who participate in IPOs from this underwriter on a regular basis) to choose a price to complete the issue.

[1] propensity of institutional investors to participate in an IPO conditional on their involvement in past IPOs by the same lead underwriter

In sum, whether they support bookbuilding or agency-based theories, previous studies regarding the effects of networks on IPO pricing do not consider that the underpricing is the joint result of the primary market pricing and the secondary market dynamics. That being so, failure to correctly relate the two stages of IPO pricing could lead to a misinterpretation of the effects of the network on the very same IPO pricing. To overcome this problem, we propose a model of primary market partial adjustment and we relate it to the network between lead underwriters and investors. Our innovative approach allows us to disentangle the effects of bookbuilding and agency-based mechanisms and lets us find confirmation of both theories in a framework where agency costs harm issuers and not only investors outside the network.

3. Framework and Hypotheses

Most research on IPO pricing has only focused on the classical underpricing measure:

$$UP = (MP - OP)/OP \quad [1]$$

where UP is the underpricing, calculated as the percentage difference between the market price (MP) (i.e. the first day closing market price) and the offer price (OP), net of the market return. The underpricing is typically seen as the amount of money left on the table by the issuing firm. Nonetheless, the underpricing summarizes the performance of the stocks in the secondary market and it is not enough to investigate the effects of networks on the whole IPO pricing process.

To provide a complete picture of the way regular investor networks affect the different stages of the IPO pricing, namely the primary and secondary markets, we propose a two-stage methodology similar to those introduced in Geranio et al. (2017) and largely discussed in Section 4. In the first stage we analyze the informational effects that a network produces on the primary market price adjustment (PA), which is the percentage difference between the final offer price and the midpoint of the initial filing price range:

$$PA = (OP - MFP)/MFP \quad [2]$$

where: PA is the price adjustment; OP is the final offer price of the IPO; MFP is the midpoint of the initial filing price range [i.e. (high price + low price) / 2].

Bookbuilding theory suggests that the presence of a network between underwriters and investors in IPOs increases the trustworthiness of the information provided by investors and this in turn is expected to lead to a more efficient information production process and a more confident pricing by the underwriter. Moreover, regular investors will likely participate in an IPO and help reduce the underwriter's risk of completing the deal (Gondat-Larralde and James, 2008) as they trade a smaller underpricing in the present in exchange for future underpriced IPOs. Ultimately this information production would lead to a higher offer price (Bajo et al., 2016) As a consequence, we test the following hypothesis:

Hp 1: A stronger network between lead underwriters and regular investors enhances the information production process and reduces the risks associated with the IPO pricing, resulting in a larger price adjustment.

Following the standard in IPO literature, we compute the price adjustment as referred to the initial filing price range. However, it often happens that underwriter(s) of an IPO amend the price range before the bookbuilding takes place. To better understand at which stage of the pricing process networks impact the primary market, we also introduce an additional primary market pricing measure which is the change in the mid filing price from the initial to the final amended one, namely what we call the "amended return":

$$AR = (MFP_{final} - MFP_{initial})/MFP_{initial} \quad [2bis]$$

This measure is expected to capture the early trend of IPO pricing because regular investors in the network might contribute to the pricing process even before the bookbuilding completion.The intuition behind this additional measure is the same as for the price adjustment; as a consequence, we consistently hypothesize that a stronger network exerts a positive effect on the amended return due to an improvement in the information production process.

In the second stage of our analysis we focus on the relationship between the price adjustment and the underpricing, which is the partial adjustment (Hanley, 1993). Indeed, a positive impact of the network on price adjustment does not imply that the offer price will be set at the maximum level; underwriters might intentionally raise the offer price by less than the information production would allow, in order to leave money on the table in a quid pro quo game with institutional investors in the network. Such behaviour will produce an excess underpricing, which means in this framework a smaller partial adjustment. We then test the following hypothesis:

Hp 2: A stronger network between lead underwriters and regular investors induces the former to a lower partial adjustment leading to an excess underpricing.

Finally, we explore the intuition that the incentives behind the underwriter's agency conflicts might change depending on how effortless the completion of the IPO is. More specifically, we expect the discussed excess underpricing to be more likely in hot IPOs rather than in cold IPOs (as suggested by Derrien, 2002 and Hanley and Wilhelm, 1995). In the latter case, the issuing company might resist leaving money on the table more strongly and the underwriter might employ a dumping ground strategy with regards to its network of institutional investors. Then we test our third hypothesis.

Hp 3: A stronger network induces a lower partial adjustment leading to an excess underpricing especially in hot IPOs; the opposite is expected in cold IPOs.

4. Data and Methodology

Data and network measures

Data for all the IPOs occurring on the Amex, NYSE, and NASDAQ exchanges from January 1997 to December 2016 were taken from the Thomson One Deals (TOD) database. As standard procedure, we excluded financial firms, ADRs, REITs, closed-end funds, non-common shares, and shares with an offer price below $5. We found 3,219 IPOs matching our criteria.

We then retrieved ownership data on the institutional investors from either the SEC filings of funds (Form N30D) or shareholder holdings (Form 13F) from the Thomson One Ownership (TOO) database. We used the first reported holdings within the first six months after the offer for each IPO as a proxy for the initial IPO allocations; despite the fact that actual allocations are not publicly available, Hanley and Wilhelm (1995) demonstrated that such proxy is highly reliable as the correlation with the actual allocations is up to 91%. Searching the database, we eventually ended up with 2,889[2] matching IPO observations with ownership data.

From the TOD and the TOO databases, we obtained lead underwriter and investor names, so that we were able to identify each lead underwriter-investor pair and observe their repeated interactions over time. We collected the names of the lead underwriters as well as the names of the co-lead underwriters (if any) of the same IPO[3]. Consistent with previous literature (Binay et al, 2007, Bohemer and Fishe, 2004), we based our network measures on the past relations between lead underwriters and institutional investors (II) in the IPO. Adding to previous contributions, we explore several dimensions of the network: first, we analyze both the network of the lead underwriter alone (LU) as well as that including all co-lead underwriters involved in the bookbuilding (ALU); second, we investigate the time dimension of the network; third, we propose three different network measures,

---

[2] The sample size will drop again after we introduce the network measures, since their computation implies the use of a time window preceeding IPOs. For example, the six month time window applied in the final model will reduce the sample by 326 observations.

[3] TOD's taxonomy actually distinguishes between "bookrunners" and "underwriters", as it is not mandatory for a bookrunner to underwrite shares but is, in fact, very uncommon. We decided to be coherent with previous literature and use the generic term of "lead underwriters".

each stressing a different aspect of the relations; finally, we add a network diffusion measure to test for the quality of the network.

Our first measure of the network relies on the number of times the institutional investors taking part in the IPO j participated in IPOs managed by the same LU in a given past time window (we computed it from 3 months to up to 3 years). The measure is the average of this count among all the investors in the IPO j, as follows:

$$Average\ NW\ LU_j = \frac{\sum_{i=1}^{II\_Nj} D_i}{II\_Nj} \quad [1]$$

where D_i is the number of past relationships between the first LU and the II i, while II_N_j is the number of institutional investors (II) participating in the IPO j.

Given that an IPO is frequently managed by more than one lead underwriter, we want to study if the network that matters the most is that of the first LU or that of all the lead underwriters (ALU) involved in an IPO, and then we recalculate the formula to find the network measure referred to ALU as follows:

$$Average\ NW\ ALU_j = \frac{\sum_{k=1}^{Lj} \sum_{i=1}^{II\_Nj} D_{ik}}{LUj \cdot II\_Nj} \quad [2]$$

where LU_j is the number of lead underwriters in the IPO j and D_{ik} is the number of past relations between LU k and investor i.

We also proposed two alternative measures of network: the first one, "*excess network*", corrects for the average network of all IPOs in the same quarter as of the IPO considered, and represents a sort of network that is in excess of what was expected (see equation [3]). The second measure, "*weighted network*", weights each pair of past relations between the lead underwriter and the institutional investor with the allocations[4],thus stressing the strength of the network with allocations (Equation [4]).

The intuition behind the excess network measure is that the average level of networks can change in time, according to various factors (such as the concentration of the investment bank or mutual fund industries, habits, or the market trend). With this indicator we want to highlight the relative strength of networks and test its effect on the IPO pricing. Weighted network measures, instead, are used here to weight past relationships for the (percentage of) shares that were allocated, thus overweighting interactions that are followed by large allocations of shares.

The following equations are the technical computation of these measures:

$$Excess\ NW\ LU_j = \frac{\sum_{i=1}^{II\_Nj} D_i}{II\_Nj \cdot E(nw_{LU\_II})} \qquad [3]$$

$$Weighted\ NW\ LU_j = \frac{\sum_{i=1}^{II\_Nj} D_i \cdot wa_i}{II\_Nj} \qquad [4]$$

As we did for the average network measure, for both excess and weighted networks we also computed the expanded versions including past relations with ALU (respectively in equations [5] and [6]):

$$Excess\ NW\ ALU_j = \frac{\sum_{k=1}^{LUj} \sum_{i=1}^{II\_Nj} D_{ik}}{LUj \cdot II\_Nj \cdot E(nw_{ALU})} \qquad [5]$$

$$Weighted\ NW\ ALU_j = \frac{\sum_{k=1}^{LUj} \sum_{i=1}^{II\_Nj} D_{ik} \cdot wa_i}{LUj \cdot II\_Nj} \qquad [6]$$

[4] We refer to the allocations, but as anticipated we use as a proxy the reported holdings in the 13F filings in the two following quarters after the IPO, which is common in the literature, such as in Reuter (2006).

where wa_i is the weighted allocation of Institutional Investor i, i.e. its allocations divided by the total allocations to all II in the IPO, so that:

$$\sum_{i=1}^{F\_Nj} wa_i = 1 \qquad [7]$$

Finally, we explore another dimension of the network, which is (to the best of our knowledge) completely absent in previous literature, that is the diffusion of the network. The before-mentioned network measures are based on the average number of past interactions between underwriters and institutional investors; as such, they can be either the result of intense relationships between a few players or the results of diluted interactions involving a larger number of players. The diffusion measure we propose here captures exactly this network dispersion and is calculated as one minus the network concentration measured as the Herfindahl index of LU-II past interactions:

$$\text{Diffusion NW LU}_j = 1 - \sum_{i=1}^{II\_Nj} \left(\frac{D_i}{\sum_{i=1}^{II\_Nj} D_i} \right)^2 \qquad [8]$$

By construction, this measure is bigger in larger networks (see the correlations in Table 3), but for a given level of average network diffusion is bigger when many investors contribute with their past relations, and smaller when only a few investors contribute. In other words, this measure somehow represents the "democracy" in the network, where the lowest value is when only one fund has many past relations with the LU and the highest value is when all funds have the same number of past relations with the LU.

Our expectation is that a bigger diffusion of a network produces more information due to the higher number of players contributing to the bookbuilding; a positive effect is then expected on the price adjustment and consequently on the underpricing. Instead, the effect of the network diffusion on the partial adjustment is a matter for empirical investigation: this will reveal if a diffused network is to be compensated, as we expected for a larger network (hypothesis 2), or if a larger compensation goes to a less diffused network.

Even for the diffusion measure we computed an expanded version considering all the IPO lead underwriters (ALU):

$$\text{Diffusion NW ALU}_j = 1 - \sum_{k=1}^{Lj} \sum_{i=1}^{II\_Nj} \left(\frac{D_{ik}}{\sum_{k=1}^{Lj} \sum_{i=1}^{II\_Nj} D_{ik}} \right)^2 \qquad [9]$$

Another dimension we investigate is the time horizon on which our network measures are computed. In the absence of an a priori expectation and lacking a prevailing choice in the literature, we performed an exploratory analysis by running all the models with network measures referred to several different windows spanning from a minimum of 3 months up to a maximum of 3 years before the IPO. The results did not change qualitatively, but the significance was highest for the 6 month window[5] which we adopted as a reference time frame in our study. This offers an insight into the IPO network mechanisms: while a 3 month network is too young to be trusted by the LU, a network older than 1 year may include old "friends" who are less committed or who have even left the network.

Methodology

Given the framework presented above, we need to apply a methodology which lets us disentangle the effects that the network exerts on the primary market pricing from those on the secondary market, bearing in mind that the two upshots of the pricing process are linked by the partial adjustment mechanism.

To test the impact of the network on the primary market pricing we estimate the following regression:

[5] Results not presented for the sake of brevity, but available on request.

$$PA = \alpha + \beta_1 \cdot Network + \gamma \cdot Controls + \varepsilon \quad [10]$$

Here the dependent variable is the price adjustment (PA), which is the output of the road show and bookbuilding efforts that lead underwriters make in the primary market.

The independent variables are divided into two groups. The first group is represented by the core network variables already described in equations [1] to [9]. We first tested standard measures of network, and we then checked if our results are robust to different network measures as presented above (the excess and the weighted network). We also tested for a measure of network diffusion.

The second group of independent variables (*Controls*) includes the control variables commonly used in the literature on IPO pricing: II_{pct} is the percentage of shares held by all institutional investors after the IPO; D_{VC} is a dummy that is equal to 1 when the IPO is venture backed; $D_{lock\text{-}up}$ is a dummy variable that is equal to 1 when the VC have a lockup obligation (which forces them to wait until a certain lockup expiration date before liquidating their stake), or zero otherwise; $LU_{reputation}$ is the reputation of the lead underwriter of the IPO according to the publicly available database provided by Ritter[6]; Size is the natural logarithm of the total assets of the company reported before the IPO; D_{tech} is a dummy variable that is equal to 1 if the company is in a high tech industry (as defined by Thomson Financial Macro Sectors classification it includes software, semiconductors, IT), or zero otherwise; D_{year} is a dummy used to capture the structural break that occurred when the internet bubble burst; it is equal to 1 before 31 March 2001 and zero after; LU_N is the number of lead underwriters of the IPO; RM_{bb} measures the equity market return during the two weeks prior to the IPO, since such a period can be considered as a proxy of the bookbuilding interval.

Equation [11] captures the standard partial adjustment phenomenon (used in Binay et al., 2007) which is the positive relationship between UP and PA (coefficient β_{PA}), when different network measures are controlled for:

[6] Which is basically the Carter and Manaster (1990) measure, adapted for more recent data.

$$UP = \alpha + \beta_{PA} \cdot PA + \beta_1 \cdot Network + \gamma \cdot Controls + \varepsilon \quad [11]$$

Nonetheless, Equation [11] itself is not suitable for describing how the level of partial adjustment changes when stronger or weaker networks are in the IPO (Geranio et al., 2017). To investigate for such an effect, we modified Equation [11] into Equation [12] by introducing an interaction term between PA and the network variables:

$$UP = \alpha + \beta_{PA} \cdot PA + \beta_1 \cdot Network + \beta_{PA,NW} \cdot PA \cdot Network + \gamma \cdot Controls + \varepsilon \quad [12]$$

As a result of the above discussion, a positive value for the coefficient $\beta_{PA,NW}$ of the interaction term (which corrects the coefficient β_{PA} representing the normal partial adjustment) would mean that, all other things being equal, in the presence of a stronger network the underpricing is increased more than expected by a given price adjustment. In other words, the offer price would be raised less than it could have been (smaller partial adjustment), thus producing a sort of excess underpricing. Therefore, a positive coefficient of the interaction term would suggest that an excess underpricing is granted to IIs in the network, and this effect is bigger when networks are stronger. On the contrary, a negative or non-significant coefficient would suggest that bookbuilding effects steadily prevail over agency-based effects in that issuers are favored at the expense of IIs in the network.

As discussed above, differences in the results may arise in relation to cold vs. hot IPOs: in cold IPOs, LUs could have more incentives to dump shares on their network, whereas in hot IPOs, LUs are more likely to compensate regular investors. To test this additional hypothesis, we split the sample into cold and hot IPOs and re-run each of the above regressions for the two subsamples. We set apart the subsamples of hot and cold IPOs with respect to the median UP, assuming that deals which were easier (more difficult) for the underwriter to complete because of the high (low) demand during the bookbuilding are also those with a subsequent higher (lower) UP.

Empirical Results

Descriptive Statistics

Table 1 reports the descriptive statistics of the network measures for the full sample, while Table 2 shows their variability in subsamples with respect to key pricing factors related to time, size, underwriter reputation (represented by the Carter-Manaster measure) and hot and cold market conditions.

Table 1

Table 2

The average network measure in Table 1 shows that IIs participating in an IPO managed by a LU, previously participated to 1,804 (on average) IPOs managed by the same LU (1,776 if we consider ALU). Table 2 shows that these interactions increase in hot and bigger IPOs, deals with higher ranked LUs; also, all network measures increase in time, and especially after the internet bubble burst of 2001.

In Table 3, we show the correlation matrix of our main variables; all these variables are statistically significantly correlated with the network and its diffusion. At a first glance, a stronger network is associated with both a larger price adjustment and a larger underpricing, but also with a smaller initial price range. This might suggest that the network allows for a better information production process which leads to less uncertainty in the IPO pricing; a larger underpricing is anyhow expected due to the standard partial adjustment mechanism previously discussed. The same is observed for the network diffusion, meaning that results are stronger when a larger number of regular investors is in the network (higher network diffusion).

Table 3

Table 4

Table 4 shows that all network variables are positively correlated, suggesting that they consistently describe the network while highlighting slightly different sides of it.

The first empirical results we illustrate here are those dealing with the effects of the underwriter-investor network on the primary market pricing (Equation 10); according to hypothesis 1 we expect the network to produce more and better information on the IPO, which in turn should result in a higher offer price and price adjustment. Table 5 shows the results.

Table 5 – PA and AR

The positive and significant coefficients of all the network measures support the information production theory and confirm our first hypothesis (*Hp. 1*) in that underwriters with a stronger network seem to better serve the interests of the issuing firm. The average network measure, which is the one similar to those used in previous literature, is the first confirming our hypothesis. However, the excess network and weighted network measures are characterized by a stronger significance, suggesting that the alternative measures of network we introduced in this paper are better at explaining the information production effect in the primary market. In other words, the information is more efficiently extracted from institutional investors when the network is larger than expected (or larger than the average) in a given time frame and when it is rewarded with larger allocations.

Table 5 also illustrates the impact of network on the amended return, an alternative measure of primary market pricing. As discussed in section 3, this measure captures the early trend of the securities' placement. Results show that regular investors in the network contribute to the pricing process even before the bookbuilding completion.

The evidence supporting hypothesis 1 confirms the bookbuilding theory, and it seems to point to a beneficial effect of the network for the IPO issuing firm. However, as we explained above, this does not exclude the existence of potential agency conflicts (or conflicts of interest) that lead to an agency cost for the issuer. We first run the model in Equation 13, which replicates the common methodology in the literature (e.g.: Binay et al, 2007, and Ritter and Zhang, 2007). Model 1 in Table 6 shows that underpricing benefits from a stronger network, as expected, since a higher PA would imply a higher UP due to the partial adjustment.

Table 6 - UP

However, as mentioned in the methodology section, in order to understand if the partial adjustment varies according to network strength we need to test Equation 14. The results of model 2 in Table 7 are the core innovative contribution of this paper, in so far as when the network is stronger underwriters set an offer price which implies a smaller partial adjustment (excess underpricing), consistent with hypothesis 2; for the first time, the existence of a cost for the issuers and a reward to regular funds in a quid pro quo game is made evident in terms of pricing.

Read together, our results show that a stronger network allows for a better information production process leading to an increase in the offer price, but conflicts of interest are also in place. In other words, the network game benefits the issuers in absolute terms (higher offer price), but in relative terms it is even more beneficial to the institutional investors in the network, and this represents a hidden agency cost for the issuer (excess underpricing).

Models 4 and 6 in Table 6 (as opposed to the naïve alternatives of models 3 and 5) show that our results are robust to different network measures, namely the excess and the weighted network. Again, we can see that the significance level is slightly higher than in models with the simple network measure.

As far as the control variables are concerned, our results confirm most of the findings of earlier studies. The number of lead managers (LU_N) shows no impact on IPO outcomes, while the reputation of the lead underwriter is positively and significantly related to PA (as in Hanley, 1993) and negatively related to UP in cold IPOs. The company size never has a significant impact on the PA, while it shows a significant and negative relation to the underpricing. The presence of a venture capitalist shareholder per se does not exert any significant impact on IPO results. However, the presence of a lockup agreement for existing venture capital shareholders reduces the PA; the same relationships also hold true when the dependent variable is UP. The IPO of a high tech company (D_{tech}) results in higher price adjustments, i.e. higher offer prices. Deals concluded before March 2001 (bursting of the internet bubble) registered both higher price adjustment and underpricing. The participation of institutional investors has a positive impact on PA (but not on UP) while a positive market return in the two weeks preceding the IPO will foster both PA and UP.

Following our framework, we now want to test how the above results differ when considering "easy" and "difficult" issues (hypothesis 3); we here assume that underwriters, given their experience and insider role in the primary market, are in the best position to produce unbiased forecasts of the underpricing, thus setting apart in advance hot and cold IPOs. For this reason, we split our sample into cold and hot IPOs with respect to the median UP. Table 7a shows that the empirical evidence we discussed above is strongly confirmed for the sub-sample of hot IPOs, but coefficients turn negative for the sub-sample of cold IPOs.

Table 7a – Hot vs Cold

An intriguing interpretation of the latter results could be: by favoring their network of investors with underpriced IPOs, underwriters gain the bargaining power to ask them to help complete cold IPOs; this intertemporal quid-pro-quo is profitable for network investors because, after all, they benefit from being part of the network. Nonetheless, it is possible that "easy" or "difficult" are not absolute time invariant characteristics for underwriters, but rather that they are related to the peculiarities of the period in which each IPO takes place. Therefore, we split our sample into cold and hot IPOs with regards to the median UP of the same quarter to which the IPO belongs.

Table 7b – Hot vs Cold Quarters

The results are presented in Table 7b, and we have a confirmation of our hypothesis: while in hot IPOs institutional investors benefit to the detriment of issuers, in cold IPOs they suffer a dumping ground. The results are stronger with the effective network measure, suggesting the importance of the allocations, together with the underpricing, in this "intertemporal quid pro quo" network game.

Summing up, we find evidence of an agency cost that issuers bear in IPOs in terms of excess underpricing which goes to institutional investors in the network. However, such a cost may be necessary to keep the players in the game in good and in hard times: institutional investors in the network earn an extra-profit in hot IPOs so that they are willing to accept the underwriters' dumping ground behavior in cold IPOs.

6. Alternative models and robustness checks

In this section, we present alternative models to improve our understanding of the results obtained with our main models and to verify that those are robust to a different specification of our models.

As an alternative model, we propose the use of a different measure of network, which is the diffusion of the network that has been introduced above. As we anticipated, the reason is that our main network measures, by construction, can present the same level of network as the results of either many past relationships between the LU and a few IIs or the results of diluted interactions involving a larger number of IIs. To investigate the role played by the diffusion or concentration of the network on IPO pricing, we run alternative models based on the "diffusion of network" presented in section 4.

As expected, our results (Table 8) show that a higher diffusion of the network is beneficial to the PA and the UP, and we can interpret this as a confirmation of the improvement that the network exerts on the information production process. On the other hand, the interaction term (representing the change in the partial adjustment) is positive and significant, which confirms previous results and adds the following interpretation: not only a stronger network leads to an excess underpricing which benefits network regular investors, but also a higher diffusion of the network, that is a network with many regular investors who will be compensated with a higher underpricing. When we split our IPOs into hot and cold, the effect on partial adjustment is only confirmed in the former case (model 4 and 6).

Table 8 – Diffusion of Network

Another dimension we explore is that of multiple lead underwriting which is indeed quite common for medium and large IPOs. Given that each lead underwriter might have its own network, such a further analysis should reveal if considering the network of all lead underwriters will add to our results.

We then ran our models with the network measures referred to all lead underwriters (Table 9). Results do not change, and the explanatory power of the models does not improve, suggesting that the network that matters more is that of the first lead underwriter[7].

Table 9 – LU_All

As a robustness check, we discuss an endogeneity issue which may affect our results: given the framework proposed in this paper, we ended up estimating regression models where the dependent variable is the underpricing and the key independent variable is the network. On the one hand, the lead underwriter is in the best position to observe the primary market demand and to predict the underpricing based on the desired level of partial adjustment; on the other hand, the underwriter is also in the position to manage the network composition of the IPO during the bookbuilding.

[7] Another interpretation could be that the other lead underwriters in an IPO usually have the same network as the underwriter.

Therefore, underpricing and network are somehow simultaneously determined. Nevertheless, the framework proposed in this paper does not imply that it is the network that determines the underpricing (even when this is our dependent variable); we only need to find the relation between the network strength and the change in the partial adjustment of the offer price and therefore in the underpricing; if this is positive (negative), we interpret this result as the underwriter (not) favoring the regular investors. However, Binay et al. (2007) showed that under this setting it would be more efficient to estimate a system of simultaneous equations with both the underpricing and the network as dependent variables. For the sake of brevity, we present the estimation of this model in the Appendix (Table A1). Our results are unaffected and are then robust to this alternative estimation method. Nevertheless, this method is not entirely suitable for our models due to the presence of the interaction term capturing the partial adjustment, which cannot be used as a dependent variable.

7. Conclusions

We analyze the effects of networks between underwriters and institutional investors on IPO pricing. The idea behind this paper is that conflicts of interest arising from being part of a network could lead to an agency cost to the detriment of the issuer. Previous literature on IPO pricing revealed a positive informational effect of networks in the bookbuilding and the presence of opportunistic behaviors carried out by underwriters, but no specific cost for the issuer has been investigated or has emerged. Thanks to an innovative framework, we add to the previous literature in that we shed light on the overall effect that underwriter-investor networks produce for IPO issuers. As a first contribution, we find evidence of a higher price adjustment in response to a stronger network; this supports the traditional bookbuilding theory and suggests that networks serve the interests of the issuing firm. Secondly, we go deeply into the relation between the network and the partial adjustment, showing that an excess underpricing (smaller partial adjustment) goes to regular investors when the network is stronger. We then conclude that investors in the underwriters' network are the ultimate beneficiaries of the network game, and that the excess underpricing represents a cost for the issuer. In other words, as an overall effect, the network game benefits the issuers in absolute terms (higher offer price), but in relative terms it is even more beneficial to the institutional investors in the network by means of an excess underpricing which is then a hidden cost for the issuer.

Third, we separately analyze hot and cold IPOs under the intuition that the degree of incentive towards regular funds might depend on how easily the IPO can be completed: we only find confirmation of favoritism by underwriters towards funds in the network in hot IPOs, whereas in cold issues a sort of dumping ground behavior is observed. This result suggests an intertemporal quid pro quo, where network investors gain an overall extra-profit, under the constraint that they will help the underwriter to complete the offer in cold IPOs. Therefore, this extra profit, which is the agency cost to the issuer, might be necessary to keep the players in the IPO game.

This agency cost proved to be well hidden in the IPO pricing, and even if it was a necessary cost, we don't know if issuers are aware of that and, if not, how they would react if they did know.

The findings of this paper suggest that institutional investors are better off when they are part of a network. But different institutional investors might have different levels of network ties. Consequently, funds belonging to stronger (weaker) networks should attain higher (lower) performances; whether this is true, and the reason why some funds may be better players in this network game, are interesting research questions and could be of interest for future research.

Table 1 – Summary statistics

The table presents the descriptive statistics of the main variables in our sample. The Initial price range is the percentage difference between the initial low and high filing prices; AR is the Amended Return that is the change in the mid filing price from the initial to the final amended one; PA is the price adjustment; UP is the underpricing; the Offer size is the dollar amount (in millions) offered in the IPO; LU_N is the number of lead underwriters of the IPO; $D_{lock\text{-}up}$ *is a dummy variable that is equal to 1 when the VC have a lockup obligation or zero otherwise.* D_{VC} *is a dummy that is equal to 1 when the IPO is venture backed and zero otherwise; LU reputation is measured by the Carter-Manaster's ranking according to the publicly available database provided by Ritter;* D_{tech} *is a dummy variable that is equal to 1 if the company is in a high tech industry (as defined by Thomson Financial Macro Sectors classification it includes software, semiconductors, IT), or zero otherwise;* D_{year} *is a dummy used to capture the structural break that occurred when the internet bubble burst; it is equal to 1 before 31 March 2001 and zero after;* RM_{bb} *measures the equity market return during the two weeks prior to the IPO (bookbuilding interval);* II_{pct} *is the percentage of shares held by all institutional investors after the IPO. Average NW LU is the average number of past relationships between the first Lead Underwriter and the Institutional Investors participating to the Ipo in the semester preceding the deal; Excess NW LU corrects the previous indicator for the average network of all IPOs in the same quarter as of the IPO considered; Weighted NW LU weights each pair of past relations between the lead underwriter and the institutional investor with the allocations received by the latter; Diffusion NW LU is one minus the network concentration measured as the Herfindahl index of past interactions between the Lead Underwriter and Institutional Investors participating to an Ipo in the semester preceding the deal. If computed considering All Lead Underwriters participating to the IPO the same networks indicators show the suffix ALU.*

	N	Min	Mean	Median	Max	Std. Deviation
Initial Price Range	2558	0.00%	13.85%	13.95%	28.57%	5.44%
AR	2558	-50.00%	-0.16%	0.00%	63.64%	15.37%
PA	2558	-53.57%	0.05%	0.00%	84.62%	23.50%
UP	2558	-23.45%	25.10%	8.31%	264.44%	48.18%
Offer Size	2558	6.9	184.736	92.214	1963.28	284.226
LU_N	2558	1	2.167	2	13	1.653
D_{Lock_up}	2558	0	0.616	1	1	0.486
D_{VC}	2558	0	0.538	1	1	0.499
LU Reputation	2558	1.001	7.851	9.001	9.001	1.765
D_{tech}	2558	0	0.332	0.000	1.000	0.471
D_{year}	2558	0.00%	0.317	0.00%	100.00%	0.465
RM_{bb}	2558	-16.68%	0.35%	0.22%	18.70%	3.85%
II_{pct}	2558	0	0.300	0.203	1.111	0.278
Average NW LU	2558	0	1.803	1.809	4.549	1.251
Average NW ALU	2558	0	1.775	1.796	4.323	1.153
Excess NW LU	2558	0	0.585	0.629	1.553	0.425
Excess NW ALU	2558	0	0.550	0.596	1.367	0.374
Weighted NW LU	2558	0	1.748	1.672	5.039	1.321
Weighted NW ALU	2558	0	2.189	2.011	6.046	1.606
Diffusion NW LU	2558	0.307	0.949	0.977	1.000	0.103
Diffusion NW ALU	2558	0.307	0.945	0.976	1.000	0.111

Table 2 – Descriptive statistics for sub-samples

The table presents the breakdown of the sample according to a few relevant dimensions. Hot and cold deals are categorized in two ways: first according to the median underpricing registered for the whole sample; secondly with reference to the average underpricing reported in the specific quarter of the Ipo completion. Issuer's Size is the value of total assets of the issuing firm the year before the IPO, where small and large refer to sizes lower or higher the median value. Lead Underwriter's reputation is measured by the Carter-Manaster's ranking according to the publicly available database provided by Ritter and (where top tiers have a rank of 9). Period historically categorizes deals between pre and post March 2001 to capture the structural break that occurred when the internet bubble burst. The Initial price range is the percentage difference between the initial low and high filing prices; PA is the price adjustment; UP is the underpricing; the Offer size is the dollar amount (in millions) offered in the IPO. Average NW LU is the average number of past relationships between the first Lead Underwriter and the Institutional Investors participating to the Ipo in the semester preceding the deal, while Average NW ALU is the same indicator referred to All the Lead Underwriters in the deal; Diffusion NW LU is one minus the network concentration measured as the Herfindahl index of past interactions between the Lead Underwriter and Institutional Investors participating to an Ipo in the semester preceding the deal, while Diffusion NW ALU is the same indicator referred to All the Lead Underwriters in the deal.

	Obs.	Initial Price Range %	PA	UP	Offer Size	Average NW LU	Average NW ALU	Diffusion NW LU	Diffusion NW ALU
UP									
Cold	1282	12.80%	-9.22%	-1.56%	237.63	1.745	1.722	0.931	0.927
Hot	1281	14.78%	9.77%	53.10%	174.81	1.863	1.830	0.968	0.963
Difference		0.0198***	0.1899***	0.5466***	-62.82***	0.118**	0.108**	0.037***	0.036***
Quarters' UP									
Cold IPOs within Quarter	1302	14.47%	-6.82%	1.50%	221.45	1.662	1.64	0.936	0.932
Hot IPOs within Quarter	1261	15.33%	7.71%	51.90%	189.99	1.946	1.911	0.963	0.959
Difference		0.0086***	0.1453***	0.504***	-31.46	0.284***	0.271***	0.027***	0.027***
Issuer's Size									
Small	1282	15.63%	4.29%	39.29%	87.93	1.457	1.436	0.959	0.958
Big	1281	12.79%	-3.64%	13.29%	324.12	2.147	2.111	0.939	0.933
Difference		-0.0284***	-0.0793***	-0.26***	236.19***	0.69***	0.675***	-0.02***	-0.025***
LU Reputation									
No Top Tier (<9)	1123	15.78%	-4.07%	20.35%	139.22	1.161	1.192	0.933	0.927
Top Tier (9)	1440	14.25%	3.75%	30.94%	258.03	2.302	2.227	0.962	0.959
Difference		-0.0153	0.0782***	0.1059***	118.81***	1.141***	1.035***	0.029***	0.0324***
Periods									
Pre 2001	1559	15.15%	3.46%	35.25%	162.48	1.471	1.453	0.964	0.963
Post 2001	1004	11.70%	-4.54%	12.39%	273.51	2.316	2.271	0.926	0.917
Difference		-0.0345***	-0.08***	-0.2286***	111.03***	0.845***	0.818***	-0.038***	-0.046***
Total	*2558*	*14.89%*	*0.33%*	*26.30%*	*205.98*	*1.802*	*1.773*	*0.051*	*0.055*

Table 3 – Correlation matrix of the main variables

The table presents correlations among the following main variables: AR is the change in the mid filing price from the initial to the final amended one; UP is the underpricing; PA is the price adjustment; II_{pct} is the percentage of shares held by all institutional investors after the IPO; Size is the (natural logarithm of the inflation corrected) total assets of the issuing firm the year before the IPO; Offer Size is the dollar amount offered in the IPO. Lead Underwriter's reputation is measured by the Carter-Manaster's ranking. Average NW LU is the average number of past relationships between the first Lead Underwriter and the Institutional Investors participating to the Ipo in the semester preceding the deal, while Average NW ALU is the same indicator referred to All the Lead Underwriters in the deal; Diffusion NW LU is one minus the network concentration measured as the Herfindahl index of past interactions between the Lead Underwriter and Institutional Investors participating to an Ipo in the semester preceding the deal, while Diffusion NW ALU is the same indicator referred to All the Lead Underwriters in the deal.

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1 – AR	1										
2 - UP	0.481	1									
	0.000										
3 - PA	0.803	0.556	1.000								
	0.000	0.000									
4 – IIpct	0.073	0.052	0.089	1.000							
	0.000	0.008	0.000								
5 - Size	-0.063	-0.241	-0.115	-0.317	1.000						
	-0.001	0.000	0.000	0.000							
6 - Offer Size	0.046	-0.090	0.052	0.072	0.364	1.000					
	-0.021	0.000	0.008	0.000	0.000						
7 - LU_Reputation	0.11	0.137	0.165	0.136	-0.017	0.096	1.000				
	0.000	0.000	0.000	0.000	0.379	0.000					
8 - Average NW LU	0.078	0.063	0.073	-0.155	0.350	0.111	0.362	1.000			
	0.000	0.001	0.000	0.000	0.000	0.000	0.000				
9 - Average NW ALU	0.086	0.067	0.078	-0.166	0.373	0.127	0.358	0.948	1.000		
	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000			
10 - Diffusion NW LU	0.113	0.121	0.149	0.206	0.117	0.012	0.177	0.073	0.081	1.000	
	0.000	0.000	0.000	0.000	0.000	0.553	0.000	0.000	0.000		
11 - Diffusion NW ALU	0.103	0.119	0.131	0.224	0.127	0.020	0.204	0.127	0.123	0.855	1.000
	0.000	0.000	0.000	0.000	0.000	0.301	0.000	0.000	0.000	0.000	

Table 4 – Correlation matrix of network variables

The table presents correlations (and related statistical significance in terms of p-value) among the following network variables: Average NW LU is the average number of past relationships between the first Lead Underwriter and the Institutional Investors participating to the Ipo in the semester preceding the deal; Excess NW LU corrects the previous indicator for the average network of all IPOs in the same quarter as of the IPO considered; Weighted NW LU weights each pair of past relations between the lead underwriter and the institutional investor with the allocations received by the latter; Diffusion NW LU is one minus the network concentration measured as the Herfindahl index of LU-II past interactions. All the network variables were also considered in their ALU version (computed with reference to All the Lead Underwriters in the deal).

	1	2	3	4	5	6	7	8
1 - Average NW LU	1							
2 - Average NW ALU	0.948	1						
	0.000							
3 – Excess NW LU	0.814	0.742	1					
	0.000	0.000						
4 - Excess NW ALU	0.724	0.764	0.917	1				
	0.000	0.000	0.000					
5 - Weighted NW LU	0.962	0.911	0.763	0.670	1			
	0.000	0.000	0.000	0.000				
6 - Weighted NW ALU	0.882	0.922	0.638	0.625	0.917	1		
	0.000	0.000	0.000	0.000	0.000			
7 - Diffusion NW LU	0.073	0.081	0.191	0.207	0.093	0.086	1	
	0.000	0.000	0.000	0.000	0.000	0.000		
8 - Diffusion NW ALU	0.127	0.123	0.230	0.243	0.142	0.116	0.855	1
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	

Table 5 – Relation between IPO network and primary market pricing measures: price adjustment and amended return

*PA is the Price Adjustment (the percentage difference between the final offer price and the midpoint of the initial filing price range); AR is the Amended Return (the change in the mid filing price from the initial to the final amended one). Average NW LU is the average number of past relationships between the first Lead Underwriter and the Institutional Investors participating to the Ipo in the semester preceding the deal; Excess NW LU corrects the previous indicator for the average network of all IPOs in the same quarter as of the IPO considered; Weighted NW LU weights each pair of past relations between the lead underwriter and the institutional investor with the allocations received by the latter; LU_N is is the number of lead underwriters of the IPO; $D_{lock\text{-}up}$ is a dummy variable that is equal to 1 when the VC have a lockup obligation or zero otherwise. D_{VC} is a dummy that is equal to 1 when the IPO is venture backed and zero otherwise; LU reputation is measured by the Carter-Manaster's ranking according to the publicly available database provided by Ritter; Size is the natural logarithm of the total assets of the company reported before the IPO; D_{tech} is a dummy variable that is equal to 1 if the company is in a high tech industry (as defined by Thomson Financial Macro Sectors classification it includes software, semiconductors, IT), or zero otherwise; D_{year} is a dummy used to capture the structural break that occurred when the internet bubble burst; it is equal to 1 before 31 March 2001 and zero after; RM_{bb} measures the equity market return during the two weeks prior to the IPO (bookbuilding interval); II_{pct} is the percentage of shares held by all institutional investors after the IPO. *, **, *** denote statistical significance at 10%, 5%, 1% respectively.*

	(1) PA	(2) PA	(3) PA	(4) AR	(5) AR	(6) AR
Average NW LU	0.010**			0.009***		
	2.341			2.821		
Excess NW LU		0.040***			0.033***	
		3.296			3.521	
Weighted NW LU			0.020***			0.015***
			4.927			4.755
LU_N	-0.001	-0.001	-0.003	0.001	0.001	-0.000
	-0.398	-0.278	-0.948	0.295	0.500	-0.122
D_{Lock_up}	-0.074***	-0.075***	-0.070***	-0.049***	-0.050***	-0.047***
	-7.279	-7.371	-6.888	-6.190	-6.319	-5.880
D_{VC}	-0.004	-0.004	-0.004	0.005	0.005	0.005
	-0.414	-0.462	-0.441	0.753	0.706	0.737
LU Reputation	0.010***	0.008***	0.008***	0.003	0.001	0.002
	3.627	2.682	2.938	1.266	0.499	0.764
Size	-0.001	-0.000	-0.003	-0.000	0.001	-0.001
	-0.400	-0.030	-1.137	-0.065	0.413	-0.653
D_{tech}	0.057**	0.057**	0.058**	0.026	0.026	0.026
	2.292	2.273	2.321	1.325	1.306	1.353
D_{year}	0.086***	0.089***	0.084***	0.054***	0.057***	0.053***
	7.006	7.222	6.845	5.652	5.886	5.492
RM_{bb}	0.726***	0.722***	0.725***	0.439***	0.436***	0.438***
	6.468	6.439	6.486	4.991	4.953	4.993
II_{pct}	0.090***	0.087***	0.094***	0.064***	0.061***	0.066***
	5.103	4.922	5.326	4.636	4.417	4.808
Industries' dummies	YES	YES	YES	YES	YES	YES
Years' dummies	YES	YES	YES	YES	YES	YES
Constant	-0.113***	-0.108***	-0.102***	-0.052**	-0.048*	-0.045*
	-3.552	-3.391	-3.221	-2.078	-1.940	-1.811
Observations	2,563	2,563	2,563	2,563	2,563	2,563
R-squared	0.201	0.202	0.207	0.119	0.120	0.124

Table 6 - Relation between IPO network and secondary market underpricing

*UP is the is the underpricing (the percentage difference between the first trading day closing market price and the IPO offer price, net of the market return). PA is the Price Adjustment. Average NW LU is the average number of past relationships between the first Lead Underwriter and the Institutional Investors participating to the Ipo in the semester preceding the deal; Excess NW LU corrects the previous indicator for the average network of all IPOs in the same quarter as of the IPO considered; Weighted NW LU weights each pair of past relations with the allocations received by the latter; LU_N is the number of lead underwriters of the IPO; $D_{lock\text{-}up}$ is a dummy variable that is equal to 1 when the VC have a lockup obligation or zero otherwise. D_{VC} is a dummy that is equal to 1 when the IPO is venture backed and zero otherwise; LU reputation is measured by the Carter-Manaster's ranking; Size is the natural logarithm of the total assets of the company reported before the IPO; D_{tech} is a dummy variable that is equal to 1 if the company is in a high tech industry or zero otherwise; D_{year} is a dummy equal to 1 before 31 March 2001(internet bubble burst) and zero after; RM_{bb} measures the equity market return during the two weeks prior to the IPO (bookbuilding interval); II_{pct} is the percentage of shares held by all institutional investors after the IPO. *, **, *** denote statistical significance at 10%, 5%, 1% respectively.*

	(1) UP	(2) UP	(3) UP	(4) UP	(5) UP	(6) UP
PA	0.972***	0.822***	0.974***	0.719***	0.964***	0.775***
	26.290	12.514	26.262	11.244	25.990	12.331
Average NW LU	0.029***	0.029***				
	3.653	3.674				
Average NW LU * PA		0.078***				
		2.756				
Excess NW LU			0.041*	0.039*		
			1.810	1.723		
Excess NW LU * PA				0.395***		
				4.870		
Weighted NW LU					0.030***	0.030***
					3.948	3.987
Weighted NW LU * PA						0.100***
						3.723
LU_N	-0.003	-0.002	0.000	0.002	-0.003	-0.003
	-0.464	-0.358	0.080	0.391	-0.552	-0.426
D_{Lock_up}	-0.058***	-0.056***	-0.064***	-0.057***	-0.057***	-0.055***
	-3.034	-2.920	-3.373	-3.014	-2.975	-2.862
D_{VC}	-0.009	-0.008	-0.009	-0.007	-0.009	-0.007
	-0.571	-0.469	-0.567	-0.426	-0.572	-0.421
LU Reputation	-0.000	-0.000	0.001	0.003	-0.000	0.000
	-0.090	-0.009	0.269	0.561	-0.051	0.014
Size	-0.016***	-0.016***	-0.013***	-0.013***	-0.017***	-0.017***
	-3.628	-3.547	-2.960	-2.886	-3.801	-3.696
D_{tech}	0.031	0.036	0.031	0.036	0.033	0.039
	0.665	0.778	0.666	0.773	0.704	0.847
D_{year}	0.210***	0.212***	0.213***	0.214***	0.208***	0.209***
	9.112	9.179	9.202	9.282	9.010	9.093
RM_{bb}	1.317***	1.295***	1.307***	1.256***	1.318***	1.299***
	6.245	6.146	6.184	5.963	6.252	6.174
II_{pct}	-0.018	-0.017	-0.027	-0.021	-0.015	-0.014
	-0.534	-0.513	-0.807	-0.640	-0.467	-0.428
Industries' dummies	YES	YES	YES	YES	YES	YES
Years' dummies	YES	YES	YES	YES	YES	YES
Constant	0.301***	0.285***	0.292***	0.259***	0.305***	0.285***
	5.066	4.790	4.898	4.335	5.138	4.800
Observations	2,563	2,563	2,563	2,563	2,563	2,563
R-squared	0.404	0.405	0.401	0.407	0.404	0.407

Table 7a – Relation between IPO network and secondary market underpricing in Hot and Cold IPOs (according to the median value of the underpricing).

*Hot and cold IPOs are defined as having respectively higher or lower underpricing than the median level. UP is the is the underpricing. PA is the Price Adjustment. Average NW LU is the average number of past relationships between the first Lead Underwriter and the Institutional Investors participating to the Ipo in the semester preceding the deal; Excess NW LU corrects the previous indicator for the average network of all IPOs in the same quarter; Weighted NW LU weights each pair of past relations with the allocations received by the latter; LU_N is the number of lead underwriters of the IPO; $D_{lock\text{-}up}$ is a dummy variable that is equal to 1 when the VC have a lockup obligation or zero otherwise. D_{VC} is a dummy that is equal to 1 when the IPO is venture backed and zero otherwise; LU reputation is measured by the Carter-Manaster's ranking; Size is the natural logarithm of the total assets of the company reported before the IPO; D_{tech} is a dummy variable that is equal to 1 if the company is in a high tech industry or zero otherwise; D_{year} is a dummy equal to 1 before 31 March 2001(internet bubble burst) and zero after; RM_{bb} measures the equity market return during the two weeks prior to the IPO (bookbuilding interval); II_{pct} is the percentage of shares held by all institutional investors after the IPO. *, **, *** denote statistical significance at 10%, 5%, 1% respectively.*

	(1) COLD UP	(2) COLD UP	(3) COLD UP	(4) HOT UP	(5) HOT UP	(6) HOT UP
PA	-0.030*	-0.037**	-0.024	0.805***	0.757***	0.729***
	-1.712	-2.262	-1.474	7.401	7.015	6.939
Average NW LU	-0.001			0.043***		
	-0.583			3.053		
Average NW LU * PA	0.009			0.121***		
	1.221			2.614		
Excess NW LU		0.000			0.025	
		0.024			0.620	
Excess NW LU * PA		0.042*			0.433***	
		1.925			3.232	
Weighted NW LU			-0.000			0.045***
			-0.277			3.359
Weighted NW LU * PA			0.006			0.154***
			0.921			3.466
LU_N	0.002*	0.002	0.002	0.007	0.015	0.006
	1.658	1.597	1.569	0.531	1.203	0.471
D_{Lock_up}	0.005	0.006	0.005	-0.070**	-0.074**	-0.066**
	1.183	1.302	1.229	-2.104	-2.239	-1.993
D_{VC}	-0.002	-0.002	-0.002	-0.009	-0.011	-0.008
	-0.619	-0.632	-0.646	-0.341	-0.402	-0.293
LU Reputation	0.001	0.001	0.001	-0.029***	-0.022**	-0.029***
	1.380	1.294	1.208	-2.763	-2.034	-2.822
Size	0.000	-0.000	0.000	-0.020**	-0.014*	-0.022***
	0.262	-0.021	0.188	-2.481	-1.692	-2.705
D_{tech}	-0.019*	-0.019	-0.020*	0.062	0.057	0.064
	-1.648	-1.606	-1.672	0.868	0.800	0.904
D_{year}	-0.001	-0.002	-0.001	0.251***	0.262***	0.247***
	-0.280	-0.341	-0.260	6.475	6.729	6.380
RM_{bb}	0.077	0.077	0.078	1.234***	1.188***	1.248***
	1.431	1.438	1.454	3.777	3.622	3.834
II_{pct}	0.026***	0.027***	0.026***	-0.147***	-0.151***	-0.142**
	3.511	3.637	3.517	-2.627	-2.690	-2.543
Industries' dummies	YES	YES	YES	YES	YES	YES
Years' dummies	YES	YES	YES	YES	YES	YES
Constant	-0.039***	-0.039***	-0.038***	0.666***	0.625***	0.675***
	-3.117	-3.156	-3.029	5.711	5.324	5.792
Observations	1,282	1,282	1,282	1,281	1,281	1,281
R-squared	0.049	0.050	0.048	0.398	0.395	0.403

Table 7b – Relation between IPO network and secondary market underpricing in Quarterly Hot and Cold IPOs.

Hot and cold IPOs are defined with respect to the median underpricing of the same quarter to which the IPO belongs. UP is the is the underpricing. PA is the Price Adjustment. Average NW LU is the average number of past relationships between the first Lead Underwriter and the Institutional Investors participating to the Ipo in the semester preceding the deal; Excess NW LU corrects the previous indicator for the average network of all IPOs in the same quarter; Weighted NW LU weights each pair of past relations with the allocations received by the latter; LU_N is the number of lead underwriters of the IPO; $D_{lock\text{-}up}$ *is a dummy variable that is equal to 1 when the VC have a lockup obligation or zero otherwise.* D_{VC} *is a dummy that is equal to 1 when the IPO is venture backed and zero otherwise; LU reputation is measured by the Carter-Manaster's ranking; Size is the natural logarithm of the total assets of the company reported before the IPO;* D_{tech} *is a dummy variable that is equal to 1 if the company is in a high tech industry or zero otherwise;* D_{year} *is a dummy equal to 1 before 31 March 2001(internet bubble burst) and zero after;* RM_{bb} *measures the equity market return during the two weeks prior to the IPO (bookbuilding interval);* II_{pct} *is the percentage of shares held by all institutional investors after the IPO. *, **, *** denote statistical significance at 10%, 5%, 1% respectively.*

	COLD UP	COLD UP	COLD UP	HOT UP	HOT UP	HOT UP
PA	0.195***	0.179***	0.197***	0.782***	0.759***	0.721***
	7.128	6.902	7.578	7.372	7.220	7.043
Average NW LU	-0.006*			0.031**		
	-1.903			2.417		
Average NW LU * PA	-0.026**			0.101**		
	-2.136			2.330		
Excess NW LU		-0.022**			0.008	
		-2.425			0.207	
Excess NW LU * PA		-0.054			0.336***	
		-1.515			2.657	
Weighted NW LU			-0.006**			0.031***
			-2.066			2.588
Weighted NW LU * PA			-0.028**			0.127***
			-2.354			3.077
LU_N	0.001	0.001	0.002	-0.003	0.003	-0.003
	0.623	0.519	0.693	-0.238	0.308	-0.252
D_{Lock_up}	-0.007	-0.007	-0.007	-0.088***	-0.094***	-0.085***
	-0.943	-0.930	-0.905	-2.811	-3.006	-2.697
D_{VC}	-0.001	-0.000	-0.001	0.020	0.018	0.020
	-0.093	-0.034	-0.110	0.775	0.709	0.795
LU Reputation	0.002	0.002	0.002	-0.022**	-0.016*	-0.022**
	0.819	1.236	0.848	-2.395	-1.672	-2.406
Size	-0.001	-0.001	-0.001	-0.014*	-0.009	-0.015*
	-0.749	-0.876	-0.655	-1.783	-1.178	-1.911
D_{tech}	0.017	0.018	0.016	0.099	0.094	0.102
	0.891	0.969	0.857	1.358	1.282	1.402
D_{year}	0.091***	0.090***	0.091***	0.435***	0.441***	0.433***
	10.553	10.429	10.592	10.964	11.082	10.914
RM_{bb}	0.526***	0.527***	0.526***	1.517***	1.476***	1.528***
	6.337	6.345	6.340	4.513	4.380	4.558
II_{pct}	0.086***	0.089***	0.086***	-0.085	-0.086	-0.082
	6.847	7.057	6.794	-1.562	-1.568	-1.513
Industries' dummies	YES	YES	YES	YES	YES	YES
Years' dummies	YES	YES	YES	YES	YES	YES
Constant	-0.036	-0.040*	-0.036	0.552***	0.521***	0.554***
	-1.590	-1.778	-1.632	5.315	4.991	5.334
Observations	1,302	1,302	1,302	1,261	1,261	1,261

R-squared	0.273	0.273	0.274	0.499	0.497	0.501

Table 8 - Relation between IPO network diffusion, price adjustment and underpricing.

*Columns 1 and 2 presents results over the full sample. Columns 3 and 4 show separately results for hot and cold IPOs defined as having respectively higher or lower underpricing than the median level, while columns 5 and 6 distinguish hot and cold IPOs accordingly to the median underpricing of the same quarter to which the IPO belongs. PA is the Price Adjustment. UP is the is the underpricing. Diffusion NW LU is one minus the network concentration measured as the Herfindahl index of lead underwriter and institutional investors past interactions; LU_N is the number of lead underwriters of the IPO; $D_{lock-up}$ is a dummy variable that is equal to 1 when the VC have a lockup obligation or zero otherwise. D_{VC} is a dummy that is equal to 1 when the IPO is venture backed and zero otherwise; LU reputation is measured by the Carter-Manaster's ranking; Size is the natural logarithm of the total assets of the company reported before the IPO; D_{tech} is a dummy variable that is equal to 1 if the company is in a high tech industry or zero otherwise; D_{year} is a dummy equal to 1 before 31 March 2001(internet bubble burst) and zero after; RM_{bb} measures the equity market return during the two weeks prior to the IPO (bookbuilding interval); II_{pct} is the percentage of shares held by all institutional investors after the IPO. *, **, *** denote statistical significance at 10%, 5%, 1% respectively.*

	PA	UP	COLD UP	HOT UP	COLD in Quarter UP	HOT in Quarter UP
PA		1.067***	-0.022*	1.212***	0.158***	1.126***
		25.820	-1.900	16.943	8.465	16.665
Diffusion NW LU	0.266***	0.362***	0.011	0.165	0.081**	0.221
	5.940	3.680	0.597	0.657	-2.390	1.174
Diffusion NW LU* PA		2.763***	0.141	6.385***	-0.274	5.083***
		-5.160	1.476	-3.948	-1.572	-3.913
LU_N	-0.001	0.001	0.002	0.010	0.000	-0.000
	-0.368	0.110	1.369	0.818	0.209	-0.042
D_{Lock_up}	-0.077***	-0.067***	0.006	-0.090***	-0.006	-0.105***
	-7.665	-3.526	1.386	-2.757	-0.815	-3.381
D_{VC}	-0.004	-0.008	-0.003	-0.018	-0.001	0.013
	-0.495	-0.525	-0.774	-0.649	-0.090	0.491
LU Reputation	0.011***	0.007	0.001	-0.015	0.000	-0.013
	4.112	1.373	0.844	-1.552	0.237	-1.474
Size	0.000	-0.013***	0.000	-0.013*	-0.002	-0.008
	0.103	-2.876	0.099	-1.691	-1.161	-1.137
D_{tech}	0.056**	0.035	-0.022*	0.056	0.018	0.095
	2.245	0.757	-1.828	0.778	0.954	1.311
D_{year}	0.087***	0.209***	-0.001	0.254***	0.092***	0.437***
	7.154	9.065	-0.179	6.547	10.678	11.031
RM_{bb}	0.739***	1.263***	0.085	1.211***	0.527***	1.503***
	6.621	5.994	1.594	3.701	6.330	4.485
II_{pct}	0.072***	-0.030	0.024***	-0.145***	0.086***	-0.079
	4.081	-0.898	3.246	-2.586	6.742	-1.438
Industries' dummies	YES	YES	YES	YES	YES	YES
Years' dummies	YES	YES	YES	YES	YES	YES
Constant	-0.089***	0.280***	-0.032**	0.609***	-0.032	0.512***
	-2.782	4.682	-2.549	5.201	-1.412	4.898
Observations	2,563	2,563	1,282	1,281	1,302	1,261
R-squared	0.210	0.407	0.051	0.396	0.273	0.500

Table 9 – Relation between IPO network of All IPO managers and price adjustment and underpricing

This table presents results of equations 10 and 12 in which networks indicators are computed considering All Lead Underwriters participating to the IPO. PA is the Price Adjustment; UP is the is the underpricing. Average NW ALU is the average number of past relationships between All Lead Underwriters and the Institutional Investors participating to the Ipo in the semester preceding the deal; Excess NW ALU corrects the previous indicator for the average network of all IPOs in the same quarter; Weighted NW ALU weights each pair of past relations with the allocations received by the latter; LU_N is the number of lead underwriters of the IPO; $D_{lock\text{-}up}$ *is a dummy variable that is equal to 1 when the VC have a lockup obligation or zero otherwise.* D_{VC} *is a dummy that is equal to 1 when the IPO is venture backed and zero otherwise; LU reputation is measured by the Carter-Manaster's ranking; Size is the natural logarithm of the total assets of the company reported before the IPO;* D_{tech} *is a dummy variable that is equal to 1 if the company is in a high tech industry or zero otherwise;* D_{year} *is a dummy equal to 1 before 31 March 2001(internet bubble burst) and zero after;* RM_{bb} *measures the equity market return during the two weeks prior to the IPO (bookbuilding interval);* II_{pct} *is the percentage of shares held by all institutional investors after the IPO. *, **, *** denote statistical significance at 10%, 5%, 1% respectively.*

	(1)	(2)	(3)	(4)	(5)	(6)
	PA	PA	PA	UP	UP	UP
PA				0.793***	0.622***	0.944***
				11.628	9.424	14.773
Average NW ALU	0.013***			0.033***		
	2.789			3.814		
Average NW ALU * PA				0.094***		
				3.084		
Excess NW ALU		0.058***			0.037	
		4.214			1.444	
Excess NW ALU * PA					0.571***	
					6.397	
Weighted NW ALU			0.020***			0.027***
			5.050			3.690
Weighted NW ALU * PA						0.009
						0.386
LU_N	-0.001	-0.000	-0.008**	-0.002	0.003	-0.009
	-0.450	-0.114	-2.151	-0.349	0.529	-1.365
D_{Lock_up}	-0.073***	-0.074***	-0.070***	-0.054***	-0.054***	-0.058***
	-7.174	-7.283	-6.917	-2.817	-2.820	-3.026
D_{VC}	-0.004	-0.004	-0.004	-0.007	-0.006	-0.009
	-0.414	-0.475	-0.444	-0.452	-0.350	-0.561
LU Reputation	0.010***	0.006**	0.008***	-0.000	0.004	0.000
	3.476	2.197	2.940	-0.030	0.757	0.064
Size	-0.001	-0.000	-0.004	-0.017***	-0.012***	-0.018***
	-0.596	-0.096	-1.429	-3.634	-2.746	-3.865
D_{tech}	0.057**	0.057**	0.058**	0.038	0.039	0.033
	2.291	2.292	2.319	0.822	0.840	0.716
D_{year}	0.086***	0.089***	0.086***	0.210***	0.212***	0.211***
	6.976	7.236	7.002	9.140	9.245	9.137
RM_{bb}	0.727***	0.722***	0.727***	1.291***	1.221***	1.318***
	6.477	6.449	6.498	6.129	5.812	6.249
II_{pct}	0.091***	0.085***	0.094***	-0.016	-0.020	-0.016
	5.151	4.850	5.334	-0.492	-0.618	-0.486
Industries' dummies	YES	YES	YES	YES	YES	YES
Years' dummies	YES	YES	YES	YES	YES	YES
Constant	-0.112***	-0.106***	-0.096***	0.281***	0.241***	0.309***
	-3.532	-3.351	-3.016	4.719	4.055	5.158
Observations	2,563	2,563	2,563	2,563	2,563	2,563
R-squared	0.201	0.204	0.207	0.406	0.411	0.404

Appendix

Table A1 – Systems of Equations with Underpricing and the Average Network as dependent variables.

*UP is the is the underpricing. PA is the Price Adjustment. Average NW LU is the average number of past relationships between the first Lead Underwriter and the Institutional Investors participating to the Ipo in the semester preceding the deal; Excess NW LU corrects the previous indicator for the average network of all IPOs in the same quarter; Weighted NW LU weights each pair of past relations with the allocations received by the latter; LU_N is the number of lead underwriters of the IPO; $D_{lock\text{-}up}$ is a dummy variable that is equal to 1 when the VC have a lockup obligation. D_{VC} is a dummy that is equal to 1 when the IPO is venture backed; LU reputation is measured by the Carter-Manaster's ranking; Size is the natural logarithm of the total assets of the company reported before the IPO; D_{tech} is a dummy variable that is equal to 1 if the company is in a high tech industry or zero otherwise; D_{year} is a dummy equal to 1 before 31 March 2001(internet bubble burst) and zero after; RM_{bb} measures the equity market return during the two weeks prior to the IPO (bookbuilding interval); II_{pct} is the percentage of shares held by all institutional investors after the IPO. *, **, *** denote statistical significance at 10%, 5%, 1% respectively.*

	(1)		(2)		(3)	
	UP	Average NW LU	UP	Excess NW LU	UP	Weighted NW LU
PA	0.819***	-0.294***	0.715***	0.028	0.764***	-0.120
	12.559	-2.754	11.232	0.773	12.263	-1.065
UP		0.469***		0.082***		0.534***
		9.158		4.699		9.902
Average NW LU	0.063***					
	8.007					
Average NW LU * PA	0.077***					
	2.735					
Excess NW LU			0.090***			
			4.017			
Excess NW LU * PA			0.393***			
			4.876			
Weighted NW LU					0.064***	
					8.629	
Weighted NW LU * PA					0.098***	
					3.687	
LU_N	-0.002		0.002		-0.003	
	-0.355		0.392		-0.422	
D_{Lock_up}	-0.055***		-0.057***		-0.054***	
	-2.899		-3.018		-2.835	
D_{VC}	-0.007		-0.007		-0.007	
	-0.466		-0.427		-0.417	
LU Reputation	-0.008	0.244***	-0.003	0.117***	-0.008	0.231***
	-1.645	19.998	-0.558	28.225	-1.597	17.996
Size	-0.022***	0.184***	-0.013***	0.013***	-0.024***	0.214***
	-4.899	19.870	-3.039	4.126	-5.296	21.970
D_{tech}	0.050	0.206***	0.033	0.064***	0.032	0.193***
	1.546	4.147	0.703	3.780	0.692	3.700
D_{year}	0.212***	-0.111*	0.218***	-0.090***	0.207***	-0.047
	9.244	-1.950	9.487	-4.639	9.042	-0.778
RM_{bb}	1.275***		1.251***		1.274***	
	6.100		5.971		6.115	
II_{pct}	-0.017		-0.021		-0.014	
	-0.509		-0.641		-0.424	
Constant	0.328***	-1.386***	0.280***	-0.429***	0.335***	-1.555***
	5.542	-11.987	4.709	-10.898	5.662	-12.785
Observations	2,563	2,563	2,563	2,563	2,563	2,563
R-squared	0.401	0.268	0.405	0.270	0.402	0.273

References

Bajo, E., Chemmanur, T.J., Simonyan, K., Tehranian, H., 2016. Underwriter networks, investor attention, and initial public offerings. Journal of Financial Economics 122. 376–408.

Benveniste, L.M., Wilhelm, W., 1990. A Comaparative Analysis of IPO Proceeds under Alternative Regulatory Environments. Journal of Financial Economics 28, 173–207.

Benveniste, L.M., Spindt, P.A., 1989. How investment bankers determine the offer price and allocation of new issues. Journal of Financial Economics 24, 343–361.

Binay, M.M., Gatchev, V.A., Pirinsky, C.A., 2007. The role of underwriter-investor relationships in the IPO process. Journal of Financial and Qyuantitative Analysis 42, 785–809.

Boehmer, E., Fishe, R.P.H., 2004. Who Receives IPO Allocations? An Analysis of "Regular" Investors, Available at SSRN. doi 10.2139/ssrn.517302

Degeorge, F., Derrien, F., Womack, K.L., 2007. Analyst Hype in IPOs: Explaining the Popularity of Bookbuilding. The Review of Financial Studies 20m 1021–1058.

Derrien, F., 2002. Issuers, Underwriters and Institutional Investors: Why They All Like the Book-Building IPO Procedure. EFA 2002 Berlin Meetings Presented Paper. Available at SSRN. doi 10.2139/ssrn.301071

Doidge, C., Karolyi, G.A., Stulz, R.M., 2017. The U . S . listing gap. Journal of Financial Economics 123, 464–487.

Geranio, M., Mazzoli, C., Palmucci, F., 2017. The effects of affiliations on the initial public offering pricing. International Review of Economics and Finance 51, 295–313.

Gondat-Larralde, C., James, K.R., 2008. IPO pricing and share allocation: The importance of being ignorant. Journal of Finance 63, 449–478.

Hanley, K.W., 1993. The underpricing of initial public offerings and the partial adjustment phenomenon. Journal of Financial Economics 34, 231–250.

Hanley, K.W., Wilhelm, W., 1995. Evidence on the strategic allocation of initial public offerings. Journal of Financial Economics 37, 239–257.

Hurt C.A., 2008, Initial Public Offerings and the Failed Promise of Disintermediation, Brigham Young University Law School Paper.

Jenkinson, T., Jones, H., 2009. IPO pricing and allocation: A survey of the views of institutional investors. Review of Financial Studies 22, 1477–1504.

Jenkinson, T., Jones, H., Suntheim, F., 2018. Quid Pro Quo? What Factors Influence IPO Allocations to Investors? Journal of Finance 73, 2303-2341.

Ljungqvist, A., Wilhelm, W., 2002. IPO allocations: discriminatory or discretionary? Journal of Financial Economics 65, 167–201.

Loughran, T., Ritter, J.R., 2002. Why Don't Issuers Get Upset About Leaving Money on the Table in IPOs?. The Review of Financial Studies 15, 413–444.

Loughran, T., Ritter, J.R., Rydqvist, K., 1994. Initial public offerings: International insights, Pacific-Basin Finance Journal 2, 165-199.

Nimalendran, M., Ritter, J.R., Zhang, D., 2007. Do today's trades affect tomorrow's IPO allocation? Journal of Financial Economics 84, 87-109.

Reuter, J., 2006. Are IPO Allocations for Sale? Evidence from Mutual Funds. Journal of Finance 61, 2289-2324.

Ritter, J.R., 1998. Initial public offerings. Contemporary Finance Digest 2, 5-30.

Ritter J.R., 2014. Google's IPO, 10 Years Later, Forbes, 7th August.

Ritter, J. R., Welch, I., 2002. A Review of IPO Activity, Pricing, and Allocations. The Journal of Finance 57. 1795-1828.

Ritter, J.R., Zhang, D., 2007. Affiliated mutual funds and the allocation of initial public offerings. Journal of Financial Economics 86. 337–368.

Rock, K., 1986. Why new issues are underpriced. Journal of Financial Economics 15, 187–212.

Sherman, A.E., Titman, S., 2002. Building the IPO order book: underpricing and participation limits with costly information. Journal of Financial Economics 65, 3–29.